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Characterization of waste — Leaching behaviour test for basic characterisation — Dynamic Monolithic Leaching Test with periodic leachant renewal under fixed test conditions

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Characterisation of waste - Leaching behaviour test for basic characterisation - Dynamic monolithic leaching test with periodic leachant renewal, under fixed test conditions

Caractérisation des déchets - Essais de comportement à la lixiviation pour la caractérisation de base - Essai de lixiviation dynamique des monolithes avec renouvellement périodique du lixiviant, dans des conditions d'essai fixes

Charakterisierung von Abfällen - Untersuchung des Auslaugungsverhaltens für die grundlegende Charakterisierung - Dynamisches Auslaugungsverfahren für monolithische Abfälle mit periodischer Erneuerung des Auslaugungsmittels unter festgelegten Prüfbedingungen

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The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This document (CEN/TS 15863:2012) has been prepared by Technical Committee CEN/TC 292 “Characterization of waste”, the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been developed primarily to support the requirements for leaching behaviour testing within EU and EFTA countries.

This document was elaborated on the basis of NEN 7345:1995.

This document specifies a dynamic leaching test for monolithic waste materials, to determine key parameters to address the leaching behaviour of monolithic waste materials.

For the complete characterization of the leaching behaviour of waste under specified conditions the application of other test methods is required, (see EN 12920).

Anyone dealing with waste and sludge analysis should be aware of the typical risks of that kind of material irrespective of the parameter to be determined. Waste and sludge samples can contain hazardous (e.g. toxic, reactive, flammable, infectious) substances, which can be liable to biological and/or chemical reaction.

Consequently these samples should be handled with special care. Gases which can be produced by microbiological or chemical activity are potentially flammable and will pressurise sealed bottles. Bursting bottles are likely to result in hazardous shrapnel, dust and/or aerosol. National regulations should be followed with respect to all hazards associated with this method.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

In the different European countries, tests have been developed to characterize and assess the constituents which can be leached from waste materials. The release of soluble constituents upon contact with water is regarded as one of the main mechanism of release which results in a potential risk to the environment during life-cycle of waste materials (disposal or re-use scenario). The intent of these tests is to identify the leaching properties of waste materials. The complexity of the leaching process makes simplifications necessary. Not all of the relevant aspects of leaching behaviour can be addressed in one single standard.

Procedures to characterize the behaviour of waste materials can generally be divided into three steps, using different tests in relation to the objective. The following test hierarchy is taken from the Landfill Directive[1] and the Decision on Annex II of this Directive[2] for disposal of waste.

a) Basic characterization constitutes a full characterization of the waste by gathering all the necessary information for a safe management of the waste in the short and long term. Basic characterization may provide information on the waste (type and origin, composition, consistency, leachability, etc.), information for understanding the behaviour of waste in the considered management scenario, comparison of waste properties against limit values, and detection of key variables (critical parameters as liquid/solid (L/S) ratios, leachant composition, factors controlling leachability such as pH, redox potential, complexing capacity and physical parameters) for compliance testing and options for simplification of compliance testing. Characterization may deliver ratios between test results from basic characterization and results from simplified test procedures as well as information on a suitable frequency for compliance testing. In addition to the leaching behaviour, the composition of the waste should be known or determined by testing. The tests used for basic characterization should always include those to be used for compliance testing.

b) Compliance testing is used to demonstrate that the sample of today fits the population of samples tested before by basic characterization and through that, is used to carry out compliance with regulatory limit values. The compliance test should therefore always be part of the basic characterization program. The compliance test focuses on key variables and leaching behaviour identified by basic characterization tests. Parts of basic characterization tests can also be used for compliance purposes.

c) On-site verification tests are used as a rapid check to confirm that the waste is the same as that which has been subjected to characterization or compliance tests. On-site verification tests are not necessarily leaching tests.

The test procedure described in this document is a basic characterization test and falls in category a).

According to EN 12920 the evaluation of the release of constituents from waste materials in a certain scenario involves the performance of various tests. This document describes one of the parametric test that can be used for such purposes, especially for monolithic waste.

The test procedure allows the determination of the release under dynamic conditions of constituents from a monolithic waste material, as a function of time. This release is calculated from the concentrations of the constituents measured in the solution (eluate) that is collected in a fixed number of separate fractions. Besides, the following test conditions are fixed: the type of leachant, the temperature, the liquid to surface area ratio, and the duration of the test.

Results of this test, combined with those from other tests (e.g. CEN/TS 14429) and the use of more or less sophisticated models, allow the identification of the main leaching mechanisms that can be distinguished,

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[1] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste.

[2] Council Decision 2003/33/EC of 19 December 2002.

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such as diffusion, dissolution of constituents, initial surface wash-off, dissolution of the matrix (see Annex A). These intrinsic properties can be used to predict the release of constituents at a given time frame, in order to assess the leaching behaviour of monolithic waste materials in practical situations or scenarios as defined in EN 12920. For assessment of the leaching under equilibrium conditions (low L/A condition, pore water and/or long contact times) there are other tools available, such as the pH dependence test CEN/TS 14429, the percolation test for granular material CEN/TS 14405 (with L/S 0,1 l/kg to 0,5 l/kg) and the batch test for granular waste EN 12457-1.

NOTE At low L/A conditions, pore water conditions in monolithic specimens can be approached.

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1 Scope

This Technical Specification is applicable for determining the leaching behaviour of monolithic wastes under dynamic conditions. The test is performed under fixed experimental conditions in this document. This test is aimed at determining the release as a function of time of inorganic constituents from a monolithic waste, when it is put into contact with an aqueous solution (leachant).

This dynamic monolithic leaching test (DMLT) is a parameter specific test as specified in EN 12920 and is therefore not aimed at simulating real situations. The application of this test method alone is not sufficient for the determination of the detailed leaching behaviour of a monolithic waste under specified conditions.

In the framework of EN 12920 and in combination with additional chemical information, the test results are used to identify the leaching mechanisms and their relative importance. The intrinsic properties can be used to predict the release of constituents at a given time frame, in order to assess the leaching behaviour of monolithic waste materials, placed in different situations or scenarios (including disposal and recycling scenarios).

The test method applies to regularly shaped test portions of monolithic wastes with minimum dimensions of 40 mm in all directions, that are assumed to maintain their integrity over a time frame relevant for the considered scenario. The test method applies to test portions for which the geometric surface area can be determined with the help of simple geometric equations. The test method applies to low permeable monolithic materials.

NOTE 1 If, in order to comply with the requirements of regular shape, the test portion is prepared by cutting or coring, then new surfaces are exposed which can lead to change(s) in leaching properties. On the other hand if the test portion is prepared by moulding, the surface will be dependent to the type of mould and the conditions of storage. If the intention is to evaluate the behaviour of the material core, the specimen needs to be stored without any contact with air to avoid carbonation.

NOTE 2 For monolithic waste materials with a saturated hydraulic conductivity higher than 10^{-8} m/s water is likely to percolate through the monolith rather than flow around. In such cases relating the release to the geometric surface can lead to misinterpretation. A percolation test is then more appropriate (e.g. CEN/TS 14405).

This procedure may not be applicable to materials reacting with the leachant, leading for example to excessive gas emission or an excessive heat release.

This document has been developed to determine the release of mainly inorganic constituents from wastes. It does not take into account the particular characteristics of organic constituents, nor the consequences of microbiological processes in organic degradable wastes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12920:2006, *Characterisation of waste — Methodology for the determination of the leaching behaviour of waste under specified conditions*

EN 14346, *Characterisation of waste — Calculation of dry matter by determination of dry residue or water content*

EN 15002, *Characterisation of waste — Preparation of test portions from the laboratory sample*

EN 16192 *Characterisation of waste — Analysis of eluates*

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696)*

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EN ISO 5667-3, *Water quality — Sampling — Part 3: Guidance on the preservation and handling of water samples (ISO 5667-3)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
eluate
solution obtained from a leaching test

[SOURCE: EN 12457-1:2002, 3.1]

3.2
laboratory sample
sample or sub-sample(s) sent to or received by the laboratory

[SOURCE: IUPAC:1997, 3.2]

Note 1 to entry: When the *laboratory sample* is further prepared (reduced) by subdividing, cutting, sawing, coring, or by combinations of these operations, the result is the *test sample*. When no preparation of the laboratory sample is required, the laboratory sample is the *test sample*. A *test portion* is removed from the *test sample* for the performance of the test or for analysis. The *laboratory sample* is the final sample from the point of view of sampling but it is the initial sample from the point of view of the laboratory.

Note 2 to entry: Several *laboratory samples* may be prepared and sent to different laboratories or to the same laboratory for different purposes. When sent to the same laboratory, the set is generally considered as a single *laboratory sample* and is documented as a single sample.

3.3
leachant
liquid that is brought into contact with the test portion in the leaching procedure

Note 1 to entry: For the purpose of this document the *leachant* is water as specified in 5.1.

3.4
leaching behaviour of a waste
release and change with time in release from the waste upon contact with a *leachant* under the conditions specified in the scenario, especially within the specified time frame

[SOURCE: EN 12920:2006, 3.4]

3.5
leachant renewal
selection of time intervals after which the *leachant* is renewed

3.6
liquid volume to surface area ratio
L*/*A
ratio between the amount of liquid (*L*) which in a given step of the test is in contact with the monolith, and the surface area of the *test portion* (*A*)

Note 1 to entry: *L*/*A* is expressed in $ml \cdot cm^{-2}$.

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3.7
monolithic waste
waste which has certain minimum dimensions and physical and mechanical properties that ensure its integrity over a certain period of time in the considered scenario

(SOURCE: EN 12457-1:2002, 3.7)

3.8
release
emission of constituents from a waste, which pass through the external surface of the waste mass, as specified in the considered scenario

[SOURCE: EN 12920:2006, 3.8]

3.9
release mechanism
physico-chemical processes that control the release of constituents from a solid into solution (leaching)

Note 1 to entry: In the case of monolithic materials, examples of these processes are diffusion, dissolution of constituents, initial surface wash-off, dissolution of the matrix.

3.10
sample
quantity that is representative of a certain larger quantity

3.11
test portion
amount or volume of the *test sample* taken for analysis, usually of known weight or volume

[SOURCE: IUPAC:1997, 3.11]

3.12
test portion of monolithic waste of regular shape
test portion of monolithic waste for which the surface area of the *test portion* can be calculated on the basis of simple geometric equations

3.13
test sample
sample, prepared from the *laboratory sample*, from which test portions are removed for testing or for analysis

[SOURCE: IUPAC:1997, 3.13]

4 Principle

This document describes a method to determine as a function of time the release of constituents from a monolithic waste material, with a leachant in contact with its surface.

The test portion of monolithic waste is placed in a reactor / leaching vessel and completely submerged in a leachant. The leachant is introduced in the reactor up to a given volume of liquid to surface area ratio (L/A ratio), at a given temperature and renewed at predetermined time intervals.

The following test conditions are fixed:

— the type of leachant;

— the temperature;

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